

# Diffusion-based Generation, Optimization, and Planning in 3D Scenes

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## Abstract

We introduce the SceneDiffuser, a conditional generative model for 3D scene understanding. SceneDiffuser provides a unified model for solving scene-conditioned generation, optimization, and planning. In contrast to prior work, SceneDiffuser is intrinsically scene-aware, physics-based, and goal-oriented. With an iterative sampling strategy, SceneDiffuser jointly formulates the scene-aware generation, physics-based optimization, and goal-oriented planning via a diffusion-based denoising process in a fully differentiable fashion. Such a design alleviates the discrepancies among different modules and the posterior collapse of previous scene-conditioned generative models. We evaluate the SceneDiffuser on various 3D scene understanding tasks, including human pose and motion generation, dexterous grasp generation, path planning for 3D navigation, and motion planning for robot arms. The results show significant improvements compared with previous models, demonstrating the tremendous potential of the SceneDiffuser for the broad community of 3D scene understanding.